

**AMENDMENTS TO THE SPECIFICATION:** identifying insertions and ~~deletions~~.

**Please amend paragraph [0005] at page 2 as follows:**

[0005] When two lithographic apparatuses are used simultaneously, this implies that there may be several patterning structures available containing the pattern to be applied to a given layer. The several patterning structures may also differ due to production tolerances. These differences may lead to differences in the images applied to the substrate or in differences of the positions on the substrates where the images are applied.

**Please amend paragraph [0006] at page 2 as follows:**

[0006] Commonly the substrates are marked with a code which is scratched into the substrate. With these codes the substrates can be identified. The relation between the identities of the substrates and the lithographic apparatuses or the patterning structures used to project images onto the substrate is stored. The combination of the stored relations and the identity of the substrates can be used to correct for the differences, based upon knowledge of the previously used lithographic apparatus or patterning structure.

**Please amend paragraph [0008] at page 2 as follows:**

[0008] On top of that, the space used ~~by~~ for a code is not available for placing integrated circuits. Many steps during the production of an integrated circuit are less expensive per integrated circuit or faster per integrated circuit when more integrated circuits ~~fit~~ are placed on one substrate, (without increasing the size of the substrate). Therefore the production costs can be decreased and the throughput can be increased by freeing space on the substrate for extra integrated circuits and refraining from reserving space of codes.

**Please amend paragraph [0059] at page 12 as follows:**

[0059] For substrate W1 the distance dxP1toP2@W1 along the x-axis between the position of the substrate reference mark P2@W1 and the substrate alignment mark P1@W1 is calculated by the identification unit IU (figure 1) using

$$dxP1toP2@W1 = xP1@W1 - xP2@W1$$

and stored as a first memory entry in the second memory unit MEM2 (figure 1) which identifies substrate W1.

**Please amend paragraph [0060] at page 12 as follows:**

[0060] For substrate W2 the distance  $dx_{P1toP2@W2}$  along the x-axis between the position of the substrate reference mark  $P2@W2$  and the substrate alignment mark  $P1@W2$  is calculated by the identification unit IU using

$$dx_{P1toP2@W2} = x_{P1@W2} - x_{P2@W2}$$

and stored in a second memory entry in the second memory unit MEM2, which identifies substrate W2.

**Please amend paragraph [0066] at page 13 as follows:**

[0066] At least some embodiments of the invention can be used to correct for differences to the engineered status of the substrates. For example, the first circuit pattern  $CP1@W1$  on substrate W1 is formed by projecting the image of the first circuit pattern  $CP1@MA1$  on patterning structure MA1 onto substrate W1 via a first lithographic apparatus LA1. The first circuit pattern  $CP1@W2$  on substrate W2 is formed by projecting the image of the first circuit pattern  $CP1@MA1$  on patterning structure MA1 onto substrate W2 via a second lithographic apparatus LA2. Due to an error in second lithographic apparatus LA2, the relative position of the first circuit pattern  $CP1@W2$  on substrate W2 and substrate reference mark  $P2@W2$  is not as defined in the corresponding memory. The error in second lithographic apparatus LA2 is known from a previous measurement and this information is shared with the first lithographic apparatus LA1.

**Please amend paragraph [0068] at page 14 as follows:**

[0068] At least some embodiments of the invention can be provided with a device or other structure to take into account the position and/or measurement errors associated with substrate alignment mark P1 and substrate reference mark P2. The defined position of the x co-ordinate  $x_{P2@W}$  of the substrate reference mark is equal for both substrates W1, W2. The defined position of the x co-ordinate  $x_{P1@W1}$  of the substrate alignment mark on substrate W1 differs from the defined position of the x co-ordinate  $x_{P1@W2}$  of the substrate alignment mark on substrate W2. Apart from these defined differences, in practice errors will also occur.

The relative distance  $dx_{P1toP2@W1}$  from substrate alignment mark P1 to substrate reference mark P2 on substrate W1 as measured can be expressed as

$$rdx_{P1toP2@W1} = dx_{P1toP2@W1} + pe1 + me1,$$

where  $pe1$  is a position error and  $me1$  is a measurement error (see figure 6). An example of a position error is the error made in the distance between the circuit pattern  $CP1@MA1$  on patterning structure MA1 and of the reference mark  $P2@MA1$  during production of the patterning structure MA1. As explained the lithographic apparatus may image the circuit pattern  $CP1@MA1$ , reference mark  $P2@MA1$  and/or alignment mark  $P1@MA1$  separately. Where in practice the image of the circuit pattern  $CP1@MA1$  is applied to each target portion C (figure 1) on substrate W1 only ± one image of reference mark  $P2@MA1$  and ± one image of alignment mark  $P1@MA1$  is applied to substrate W1. The imaging is done using information on the relative positions on patterning structure MA1 and the defined positions on substrate W1.

**Please amend paragraph [0069] at page 14 as follows:**

[0069] In the event the relative distance between reference mark  $P2@MA1$  and circuit pattern  $CP1@MA1$  on the patterning structure MA1 is not measured and accounted for during the steps of imaging the reference mark  $P2@MA1$  and the circuit pattern  $CP1@MA1$  onto substrate W1, the relative distance  $rdx_{CP1toP2@W1}$  may not be equal to  $dx_{CP1toP2@W1}$ .

**Please amend paragraph [0072] at page 15 as follows:**

[0072] Both measured relative distances  $rdx_{P1toP2@W1}$  and  $rdx_{P1toP2@W2}$  may contain error terms. Identification unit IU compares the measured distance  $wD$  to the defined distances  $dx_{P1toP2@W1}$  and  $dx_{P1toP2@W2}$  between substrate alignment mark P1 and substrate reference mark on substrate W1 and substrate W2. It is possible that none of the defined distances  $dx_{P1toP2@W1}$  and  $dx_{P1toP2@W2}$  will be equal to the measured distance  $wD$ . Identification unit IU will determine the difference between the measured distance  $wD$  and each of the defined distances. The defined distance with the smallest difference to the measured distance  $wD$  may be selected as identifying the substrate. In the event  $|wD - dx_{P1toP2@W1}| < |wD - dx_{P1toP2@W2}|$  the identification unit IU will identify the substrate as substrate W1. In the event that  $|wD - dx_{P1toP2@W1}| > |wD - dx_{P1toP2@W2}|$ , the identification unit IU will identify the substrate as substrate W2.

**Please amend paragraph [0073] at page 15 as follows:**

[0073] On the second substrate W2 the defined position of the x co-ordinate  $x_{CP1@W1}$  for the first circuit pattern is equal to that on substrate W1. On the second substrate W2 the defined position of the x co-ordinate  $x_{P2@W2}$  is also equal to that on substrate W1 ~~also~~. On both substrates W1, W2 the position of the first circuit pattern  $CP1@W1$ ,  $CP1@W2$  can be determined by measuring the x co-ordinate  $x_{P2@W1}$ ,  $x_{P2@W2}$  of the substrate reference mark and accounting for the defined relative positions of the first circuit pattern  $CP1@W1$ ,  $CP1@W2$  and the substrate reference mark  $P2@W1$ ,  $P2@W2$ . This distance will be referred to as  $d_{CP1toP2@W}$ . The relation is

$$x_{CP1@W} = x_{P2@W} + d_{CP1toP2@W}. \quad (1)$$

**Please amend paragraph [0075] at page 16 as follows:**

[0075] On the processed substrate W1 the distance will be referred to as  $rd_{CP1toP2@W1}$ . The relation with the defined distance  $d_{CP1toP2@W}$  is

$$rd_{CP1toP2@W1} = d_{CP1toP2@W1} + \epsilon_1. \quad (2)$$

**Please amend paragraph [0078] at page 16 as follows:**

[0078] Likewise ~~the~~ on substrate W2, defined distance between first circuit pattern  $CP1@W2$  on substrate W2 and substrate alignment mark  $P1@W2$  will be  $d_{CP1toP1@W2}$  and the realised distance will be  $rd_{CP1toP1@W2}$ . The relation can be expressed as

$$rd_{CP1toP1@W2} = d_{CP1toP1@W2} + \delta_2, \quad (4)$$

wherein  $\delta_2$  is a position error similar to position errors  $\epsilon_1$  and  $\delta_1$ .

**Please amend paragraph [0079] at page 16 as follows:**

[0079] The measured x co-ordinate  $x_{P2@W1}$  of substrate reference mark  $P2@W1$  can be expected to be at

$$x_{P2@W1} = x_{P2@W1} + \xi_1. \quad (5)$$

**Please amend paragraph [0083] at page 16 as follows:**

[0083] Once both the substrate reference mark  $P2@W1$  and the substrate alignment mark  $P1@W1$  are formed on the substrate W1 and ~~the~~ substrate W1 is developed, both their

positions can be read and can be used to determine the position of the first circuit pattern CP1@W1 on substrate W1.

**Please amend paragraph [0084] at pages 16 and 17 as follows:**

[0084] The position of the first circuit pattern on substrate W1 can be estimated from

$$x_{CP1@W1} = x_{P2@W1} + d_{CP1toP2@W1}. \quad (7)$$

Note that here the defined distance between CP1toP2@W1 is used instead of the realised distance, since the realised position of first circuit pattern xcp1@w1 can not be measured.

**Please amend paragraph [0085] at page 17 as follows:**

[0085] The position of first circuit pattern on substrate W2 can be derived from

$$x_{CP1@W2} = x_{P2@W2} + d_{CP1toP2@W2}. \quad (8)$$

**Please amend paragraph [0086] at page 17 as follows:**

[0086] The position of the first circuit pattern CP1@W1 on substrate W1 can also be estimated from a measured position of substrate alignment mark P1@W1. This can be done via

$$x_{CP1@W1} = x_{P1@W1} + d_{CP1toP1@W1}. \quad (9)$$

**Please amend paragraph [0087] at page 17 as follows:**

[0087] For substrate W2 the position of the first circuit pattern CP1@W2 can be estimated via

$$x_{CP1@W2} = x_{P1@W2} + d_{CP1toP1@W2}. \quad (10)$$

**Please amend paragraph [0088] at page 17 as follows:**

[0088] After identification of the substrate, it is known if the substrate contains substrate alignment mark P1@W1 or P1@W2, i.e. if the substrate is substrate W1 or substrate W2. In the event the substrate is substrate W1, the position of the first circuit pattern can be estimated using either the measured position of the substrate reference mark (formula 7) or the measured position of the substrate alignment mark (formula 9). The estimation can also use the measured position of both the substrate reference mark and the measured position of

the substrate alignment mark in order to reduce the error terms. The effect of adding the two estimations of formula 7 and 9 and dividing the result by 2 is

$$x_{CP1@W1} = (x_{P2@W1} + d_{CP1toP2@W1} + x_{P1@W1} + d_{CP1toP1@W1})/2. \quad (11)$$

**Please amend paragraph [0089] at page 17 as follows:**

[0089] Filling in formula 5,2,6 and 3 clarifies how the errors translate into the estimated  $x_{CP1@W1}$

$$x_{CP1@W1} = (x_{P2@W1} + \xi_1 + d_{CP1toP2@W1} - \epsilon_1 + x_{P1@W1} + \zeta_1 - d_{CP1toP1@W1} + \delta_1)/2. \quad (12)$$

**Please amend paragraph [0094] at page 18 as follows:**

[0094] It will be clear to a person skilled in the art, that any feature on the substrate or of the substrate of which the position can be determined, could replace the substrate reference mark. It will be clear to a person skilled in the art, that the relative positions of the substrate reference marks and the substrate alignment marks may indicate or contain information characterising the substrate such as a date, a serial number processing information or factory information. It may also be the number of substrates within a series with the same characteristics. Together with the serial number, for instance 7, the number of substrates within a series of for instance 9 substrates would indicate that it concerns substrate number 7 of 9 substrates. In all these cases, this characterising information regarding the substrate may be encoded in the relative positions. The characterising information regarding the substrate can be decoded ~~only~~ with a known relation between the relative positions and the characterising information corresponding to certain relative positions. It will be understood that the characterising information regarding the substrate such as date, serial number, processing information or factory information can be considered to identify a substrate or set of substrates.

**Please amend paragraph [0095] at pages 18 and 19 as follows:**

[0095] It will be clear to a person skilled in the art, that the characterising information may be used to calibrate the lithographic apparatus. For instance, the identity of a calibration substrate may be associated with height information such as the difference in height between two positions on the substrate  $(x_1, y_1, z_1), (x_2, y_2, z_2)$  (not shown). Differences in height are distances along the z-axis (figure 1). The measured distance is compared with a previously

measured distance according to the characterising information. The ratio between the previously measured distance and the measured distance can be used as a calibration ratio. Multiplying measured z-co-ordinates on the calibration substrate with the calibration ratio will result in calibrated z-co-ordinates. In other words, the lithographic apparatus is calibrated.